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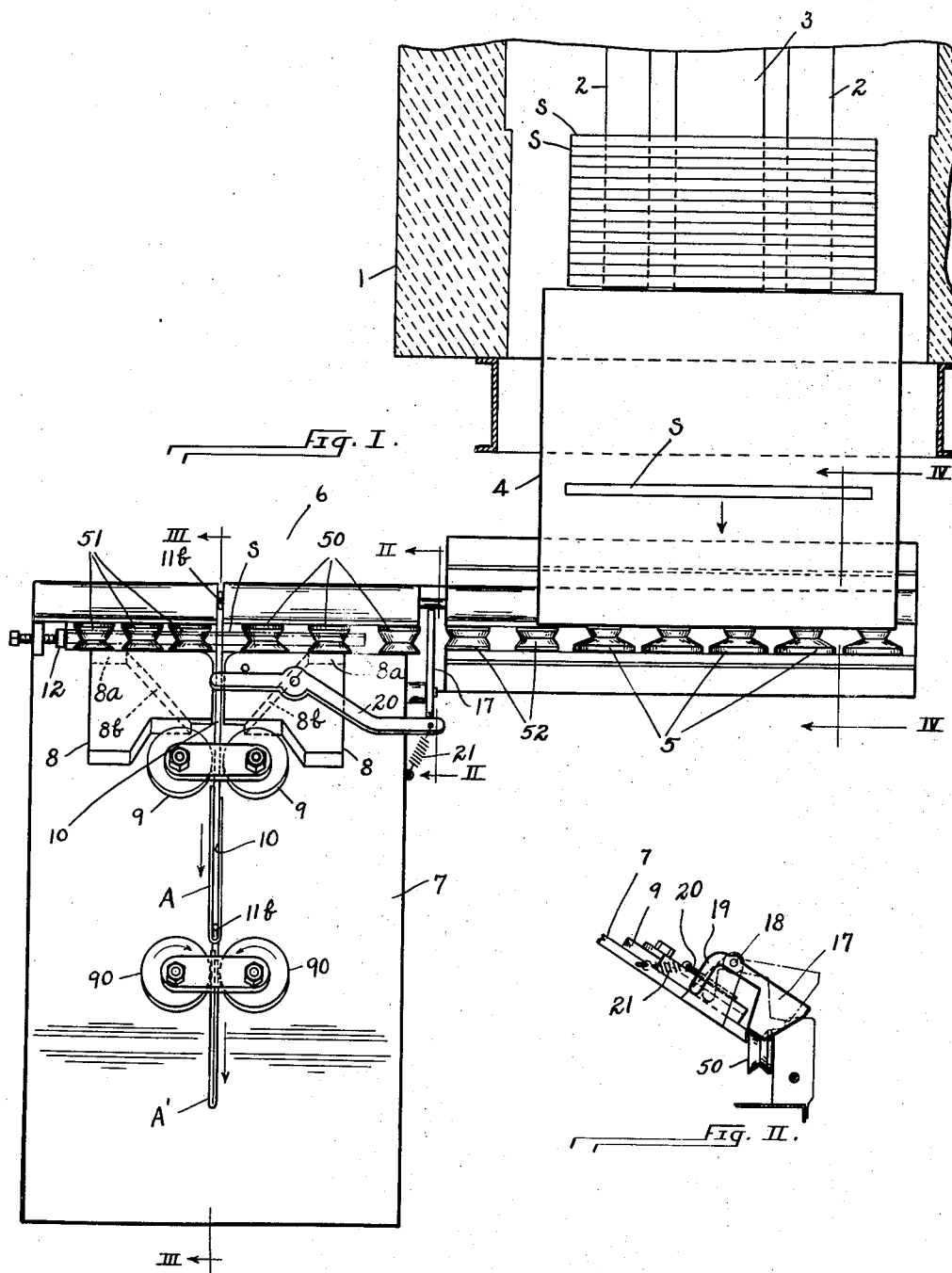
W. H. STOCKING ET AL

2,202,017

BENDING MACHINE

Filed May 23, 1938

2 Sheets-Sheet 1



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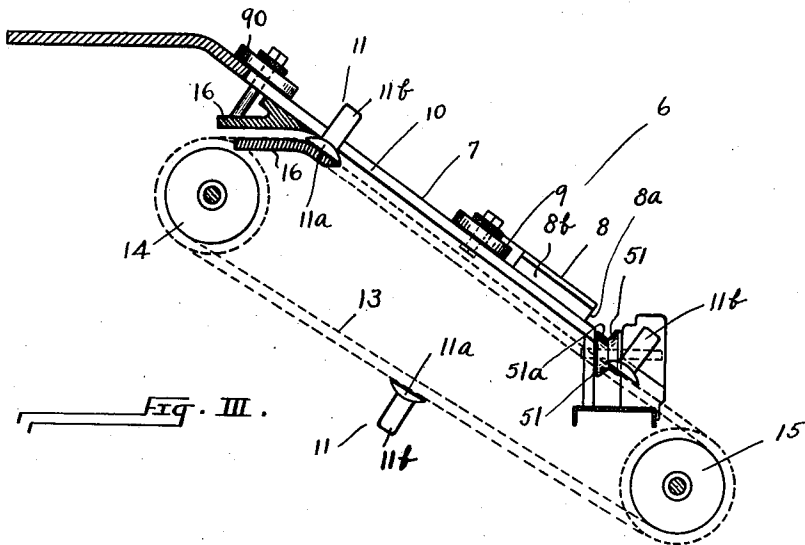


Fig. III.

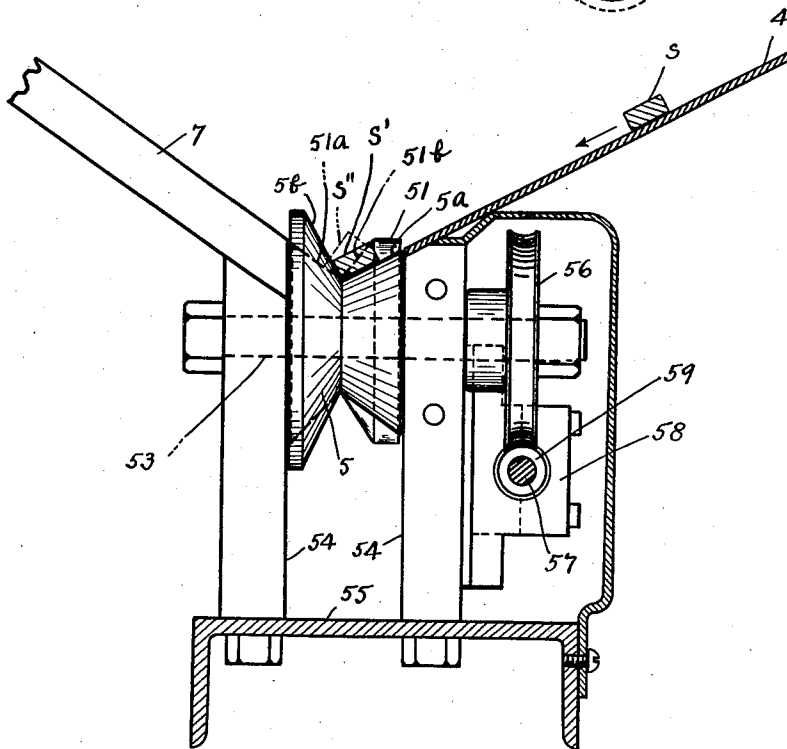


Fig. IV.

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UNITED STATES PATENT OFFICE

2,202,017

BENDING MACHINE

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9 Claims. (Cl. 153—21)

Our invention relates to the bending of metal, and is found in an improved apparatus for bending straps of steel into U-shaped articles, in this case into U-shaped blanks that are adapted to be die-forged into rail fasteners of the sort described in Letters Patent of the United States No. 2,015,194, granted September 24, 1935, to one Max Ruping.

A machine embodying the invention is illustrated in the accompanying drawings, in which Fig. I is a view of the machine arranged at the delivery end of a heating furnace. The machine is shown in plan from above, and the furnace is shown fragmentarily in horizontal section. Fig. II is a fragmentary view of the apparatus, illustrating in side elevation (on the plane II—II of Fig. I) a particular gate that controls movement of the work in the machine. Fig. III is a view of the machine in longitudinal section, on the plane III—III of Fig. I. And Fig. IV is a fragmentary view, showing certain parts of the machine to larger scale and on the section plane IV—IV of Fig. I.

Referring to the drawings, the machine of the invention is organized at the delivery end of a furnace 1, in which straps 3 of steel, cut to accurate length, are heated to proper working temperature. In the furnace the straps are aligned upon two supporting rails 2, 2, and in known way a walking beam 3 operates between the rails, to inch the line of straps forward upon the rails, through such intervals that, with each oscillation of the walking beam, the leading strap in the line is shoved from the ends of the rails at the discharge end of the furnace.

The apparatus includes a plate 4 that slopes downward from the ends of the rails 2, 2 to a conveyor; advantageously the conveyor consists in a line of rotating rolls 5 arranged at the lower edge of the plate, and preferably the rolls are circumferentially grooved. It will be understood that the aligned grooves of the rolls form a work-receiving channel that extends adjacent to and in parallelism with the lower edge of the plate 4. The heated straps of steel that are discharged one by one from the furnace slide down the plate 4 into such channel, and as each strap enters the channel the rotating rolls propel it in axial direction to a bending machine 6.

The bending machine includes a bed-plate 7 supporting two blocks 8, 8 and a pair of rolls 9, 9. These blocks and rolls form a pass through which the straps are advanced and in which the advancing straps are bent or folded into the desired U-shaped articles. The bed-plate is in

this case inclined to the horizontal throughout the greater portion of its length; the inclined body portion of the bed-plate includes a medial slot 10 that opens through the lower edge of the plate; the blocks 8, 8 are rigidly secured to the bed-plate, and the rolls 9, 9 are mounted on rigid axles that rise perpendicularly from the surface of the bed-plate; and, as shown in Fig. I, the blocks 8, 8 and rolls 9, 9 are arranged symmetrically on opposite sides of the slot 10, and form between them the strap-bending pass alluded to. At the lower edge of the bed-plate two sets of grooved rolls 50 and 51 are trunnioned, forming a channel that is aligned with the channel formed by the rolls 5. And between the two sets of rolls 5 and 50 two grooved rolls 52 are provided. For reasons presently to appear, the rolls of the several sets vary in particular details of contour, but it will be perceived that all of the rolls are aligned—the grooves of the rolls providing in effect a continuous channel extending from the lower edge of inclined plate 4 at the discharge end of the furnace to the lower edge of inclined bed-plate 7 of the bending machine. The rolls are powerfully rotated, in such direction that the heated straps, discharged from the furnace and sliding down the inclined plate 4 into the aligned grooves of the rotating rolls, are propelled in right-to-left direction (Fig. I), to position against a stop 12 provided on the bed-plate 7. (It is unnecessary to drive all rolls in the line, and in this case only the rolls 5, 50, 52 are positively driven.)

The means for driving the rolls may be of widely varied construction. In this case each driven roll is splined on an axle 53 (Fig. IV); each axle is trunnioned in a pair of standards 54 on a frame member 55, and, extending from the standards, each axle carries a worm-gear 56. A countershaft 57, mounted in suitable bearings 58 and geared to the drive shaft of a suitable electric motor (not shown), extends beneath the projecting axles of the rolls, and carries worm-pinions 59 that severally mesh with the worm-gears 56. In service the shaft 57 is continuously rotated and the rolls 5, 50, and 52 are powerfully rotated in the manner described.

The bending machine includes means for advancing the heated straps successively brought to position against the stop 12 through the pass 8, 8—9, 9. Such means consist in a plurality of dogs 11 secured in known way to an endless chain 13. The chain is trained upon sprocket-wheels 14 and 15 beneath the bed-plate 7, and extends in common vertical plane with the slot 10 in such

bed-plate. The sprocket-wheel 14 is geared to an electric motor (not shown), and the travel of the chain 13 in its upper reach is in right-to-left direction (Fig. III). The dogs 11 are spaced 5 apart in the circumferential extent of the chain; each dog includes a laterally flanged basal portion 11a and a blade portion 11b extending perpendicularly from such basal portion; and in the operation of the machine these dogs, upon 10 moving in counterclockwise direction around the sprocket-wheel 15, advance between the two sets of rolls 50 and 51, and their blade portions 11b enter the slot 10 that opens through the lower edge of the bed-plate 7. The dogs travel 15 with their flanged basal portions beneath the bed-plate, while their blade portions, extending through the slot 10, project a substantial interval above the face of the bed-plate. As will presently appear, the operations of the apparatus are 20 so synchronized that a strap S is positioned against the stop 12 immediately before each dog rounds the sprocket-wheel 15 and enters the slot 10.

In Fig. I a strap S is shown in broken lines, supported on the rolls 50, 51 against stop 12, and the blade portion 11b of one of the dogs borne by the chain is shown in course of movement into the slot 10. As such advancing blade portion moves between the two sets of rolls 50, 51, it engages the strap S medially and carries it forward, 30 bringing the opposite ends of the strap to position against the edges 8a, 8a of the blocks 8, 8. Inward from such edges the bodies of the blocks are recessed, providing two inclined edges 8b, 8b that converge toward the pass formed by and between the rolls 9, 9. The advance of the blade 11b continues without interruption, and, while the strap at its opposite ends abuts upon the block edges 8a, 8a, the advancing blade bends 40 the strap and carries its medial body portion between the blocks 8, 8. As the body of the strap is thus being bent, the limbs extending from opposite sides of the bend swing angularly from the block edges 8a, 8a into the form of a V. The advancing blade 11b carries the strap, with the apex of the V in the lead, between the convergent edges 8b, 8b of the blocks 8, 8 and through the pass between rolls 9, 9. While the V-shaped strap is thus drawn between edges 8b, 8b and rolls 9, 9, the legs of the V are gradually swung inward, toward the pass line of the machine, and, upon emerging from the rolls 9, 9, the two legs extend in close parallelism on opposite sides of the bend, and form a narrow U-shaped article, 55 as shown at A in Fig. I.

The article A may in some cases be the ultimate product of the machine. If so, it is removed from the traveling blade 11b as it emerges from and clears the rolls 9, 9. In other cases it may 60 be desired to have the two limbs of the U closed in tight surface-to-surface contact. In the latter event a second pair of rolls 90, 90 is provided in the machine. The rolls 90, 90 are fixed to their axles, and the axles are suitably geared to a motor (not shown) for rotating the rolls in the direction of the arrows (Fig. I). The blades 11b 65 advance in the slot 10 to such point that the articles A engaged thereby are introduced between and engaged by the powerfully rotated rolls 90, 90. Beneath the bed-plate of the machine, means are provided for withdrawing the blades from the articles A when they are engaged by the rolls 90, 90, and conveniently such means consist in guiderails 13, 16 (Fig. III), between 70 which the laterally extending flanges 11a of the

traveling dogs are engaged. The guide-rails are so organized with the upper reach of the chain 13 that, by virtue of the engagement between the flanges of the dogs and such guides, the direction of travel of the chain is deflected from a 5 course parallel with the bed-plate 7; that is to say, as the traveling dogs approach the sprocket-wheel 14, the direction of travel abruptly changes with respect to the bed-plate, with the consequence and effect that the blade 11b of each advancing dog is withdrawn from the slot 10 at the point at which the article A, propelled by the dog, is engaged by the rolls 90, 90. Freed from 10 engagement with the dog, the article is by the powerfully rotated rolls advanced, and the opposite limbs of the article are closed in surface-to-surface contact, as shown at A' in Fig. I. The article thus formed provides the blank from which is fashioned the rail fastener mentioned at the beginning of this specification. Thus, it will be 20 perceived that the straps S, ejected in succession from the furnace 1, are automatically fed to the bending machine and formed into the desired articles.

To the end that there shall be perfect synchronizing of the feeding of the straps with the operations of the bending machine, we provide means that properly time the feeding of the straps S to the work-supporting rolls 50, 51 of the bending machine. Such means are found in 30 a gate 17, pivotally mounted on a horizontal axis 18 and adapted to swing on such axis between a position in which the line of strap advance on the rolls is closed and a position in which such line is open. The gate 17 is equipped with a vertical arm 19 (Fig. II). A lever 20 is pivoted intermediate its ends (in this case to the face of one of the blocks 8), to swing in a plane parallel to the bed-plate 7. The gate 17, under the influence of gravity, normally stands in the position illustrated in full lines in Fig. II, in which position 40 it blocks the path through which the straps move from rolls 5, 52 to rolls 50, 51, and, under the influence of a spring 21, the lever 20 normally lies in the position shown in Fig. I, with the inner end of the lever athwart the pass line of the bending machine and the outer end adjacent to the arm 19 of the gate. In the operation of the bending machine, the upper end of each blade 11b advancing between the blocks 8, 8 engages the inner end of lever 20; the lever is swung counterclockwise, as viewed in Fig. I; and the outer end of the swinging lever engages and swings the arm 19 counterclockwise, as viewed in Fig. II, and the gate 17, integral with such arm, swings into its 55 broken-line position (Fig. II), in which the way is opened for the advance of a strap over the rolls. The engagement between the blade 11b and the lever 20 is momentary only, and, as the advancing blade sweeps clear of the tip of the lever arm the parts return to illustrated positions. Thus, it will be understood that the straps S can enter the rolls 50, 51 of the bending machine only when the gate is raised, and the gate is raised only when a blade 11b moves between the blocks 8, 8 and carries the strap which had been positioned on the rolls 50, 51 into the bending machine. Needless to say, the strap-ejecting means (3) of the furnace are operated at such speed that the heated straps are delivered at a rate no greater than the capacity of the bending machine. The automatic gate 17 serves more accurately to synchronize the delivery of straps with the operation of the bending machine.

An important feature of design in the strap- 75

feeding rolls 5, 50, 51 remains for consideration.

The circumferential grooves of these rolls are, advantageously, of V-shape in cross-section; the grooves in the rolls 5 are so shaped and the rolls are so mounted at the lower edge of the inclined plate 4 that, at the upper limb of each roll, one leg of the V (leg 5a, Fig. IV) extends in alignment with the upper surface of the plate 4, while the other leg (leg 5b) of the V extends at an angle of 90 degrees thereto. The inclined annular surfaces that form the walls of the groove in each roll are in fact the side surfaces of two conical frusta that are axially aligned, with the convergence of each directed toward the other, and in the machine assembly one of such conical surfaces is tangent with the plane of the surface of the plate 4. In like manner the grooves in rolls 50, 51 are of V shape, and are arranged with their frustoconical surfaces 51a tangent to the plane of the bed-plate 7. (Note Figs. III and IV.) By virtue of such refinement in roll structure and organization, the heated straps of steel readily slide from the inclined plate 4 to desired position on the rolls 5, and, upon being conveyed to position on the rolls 50, 51, the straps readily slide, each under pressure of an advancing blade 11b, from the rolls to desired position on the bed-plate 7 of the bending machine.

It is important additionally to note that the grooves in the rolls are so designed that the straps are always presented in correct position to be engaged by the advancing blades of the bending machine. When each strap slides down the plate 4, it enters the rolls 5 in the position indicated at S' in Fig. IV. And, as the strap is by the rotating rolls advanced to the bending machine, it is axially turned to the position indicated by the dotted lines S'' (Fig. IV). That is to say, as the strap advances to the rolls 50, 51, it is tilted into such position that its lower edge lies flush with the plane of the bed-plate surface—the proper position for entrance to the bending machine. This tilting of the straps is achieved, by means of the intermediate rolls 52, whose V-shaped grooves are properly modified in shape, to effect the axial turning of the straps as they pass from rolls 5 to rolls 50.

In the foregoing specification and the appended claims, we employ the word "strap" to indicate the blanks which are delivered to the bending machine. It is to be understood that straps shall cover blanks in the form of rods, bars, and other elongate sections that are to be bent or otherwise formed in a metal-working machine.

We claim as our invention:

1. A machine including two roll passes arranged one before the other on a common pass line, two spaced-apart abutments arranged, at the entrance to the first pass, one on each side of the pass line, and means including a member advancing on said pass line and adapted medially to engage a strap of steel positioned against said abutments, and, by advance between the abutments, to bend the strap and carry it, with the bend in the lead, between the abutments, through the first pass, and into the second.

2. A machine including a pair of rolls forming a work-shaping pass, two blocks including tapering edges arranged at the entrance to the pass, one on each side of the pass line and providing a convergent passage leading to said roll pass, said blocks providing an abutment on each side of the mouth of said convergent passage, means for supporting a strap of steel across, and with

its opposite ends adjacent to, said abutments, and an endless traveling chain carrying a dog advancing on said pass line, said dog being adapted medially to engage said strap of steel and, by advancing between the abutments, to bend the strap and carry it, with the bend in the lead, through said convergent passage and into and through said roll pass.

3. The structure of the next-preceding claim, in which the means for supporting said strap adjacent to said abutments consist in a line of rolls extending transversely of said pass line.

4. In combination with a metal-shaping machine including a member having a surface adapted to receive and support a blank to be shaped, means including a blank-supporting surface for receiving blanks delivered in succession from a source of supply, and a line of rotary rolls adapted to receive the blanks delivered to said means and to convey them to said machine, said rolls being formed with circumferential grooves including annular groove surfaces that are inclined to the axes of the rolls, the inclined annular groove surfaces of the rolls at one end of the line being tangent with the plane of the blank-supporting surface of said means, and the inclined annular groove surfaces of the rolls at the other end of said line being tangent to the plane of the blank-receiving surface of said machine.

5. The structure of the next-preceding claim, in which the grooves of the rolls are of V-shape in cross-section, with the angularity of the V in successive rolls in the line varied, substantially as described.

6. A bending machine including a roll pass and means for bending a strap of steel and carrying it, with the bend in the lead, through said pass, in combination with mechanism for delivering straps to such machine, said mechanism including a line of rotating rolls extending transversely to the pass line of said machine and adapted at one end of the line to receive straps and by roll rotation to deliver the straps in succession to the bending machine at the other end of said line, a gate arranged intermediate the ends of said line of rolls, said gate being movable between a position in which the straps may advance to said bending machine and a position in which the advance of the straps is arrested, and means synchronized with the operation of the bending machine for moving said gate between such positions.

7. A heating furnace including means for discharging heated straps from its delivery end, a bending machine including means for supporting a heated strap and an instrumentality movable relatively thereto for bending the supported strap, and means for feeding the straps discharged from said furnace to said supporting means of the bending machine, said last means including a gate movable in coordination with said bending instrumentality, between a position in which straps may advance to said bending machine and a position in which such advance is arrested.

8. A heating furnace including means for discharging heated straps from its delivery end, a bending machine including means for supporting a heated strap and an instrumentality movable relatively thereto for bending the supported strap, and means for feeding the straps discharged from said furnace to said supporting means of the bending machine, said last means including a line of grooved conveyor rolls, together with a gate movable in coordination with said bending instrumentality, between a position in which straps

may advance to said bending machine and a position in which such advance is arrested.

9. In apparatus including a metal-shaping machine including a member having a surface adapted to receive and support a blank to be shaped, and a line of rotary rolls arranged to deliver blanks to said machine, the refinements herein described in which said line of rotary rolls include

a plurality of rolls formed with grooves of V-shape in cross section and arranged adjacent to one edge of said surface, one leg of the V in each roll lying substantially flush with and forming in effect a portion of such surface of the machine.

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